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(54) Abstract Title
Transmitting data type identification to enable reconstruction near reciever rather than complete data signal

(57) In a network such as a telecommunications network, the bandwidth consumed in reduced by identifying data of certain predetermined types such as Music-on-Hold and signalling across the network that the data is of a defined type so that the information can be reconstructed at a point in the network closer to the destination than to the source of the data. A method of transmitting coded speech is also disclosed.

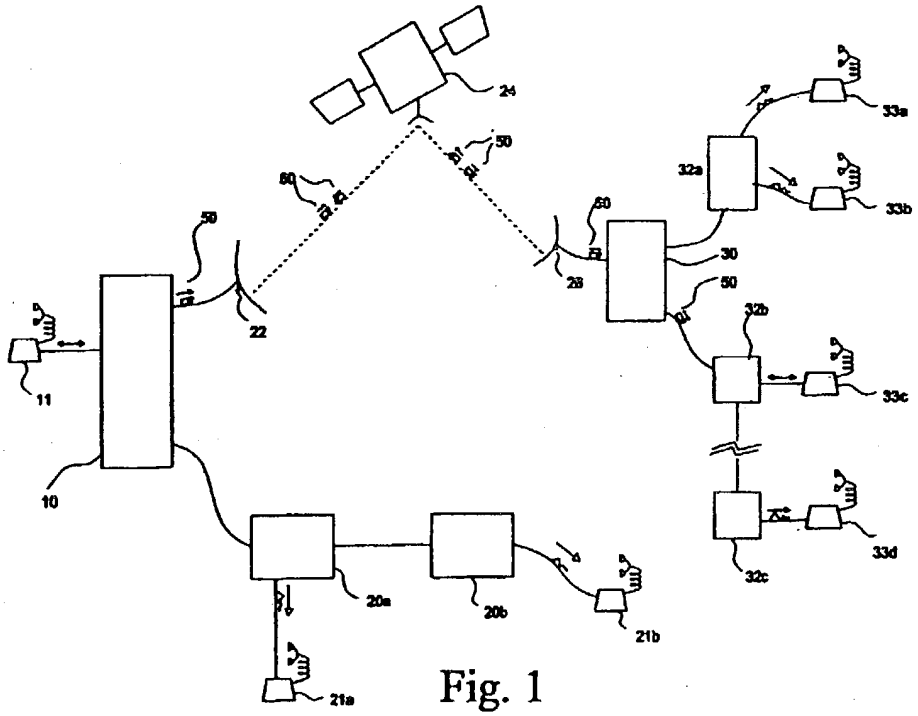

Fig. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

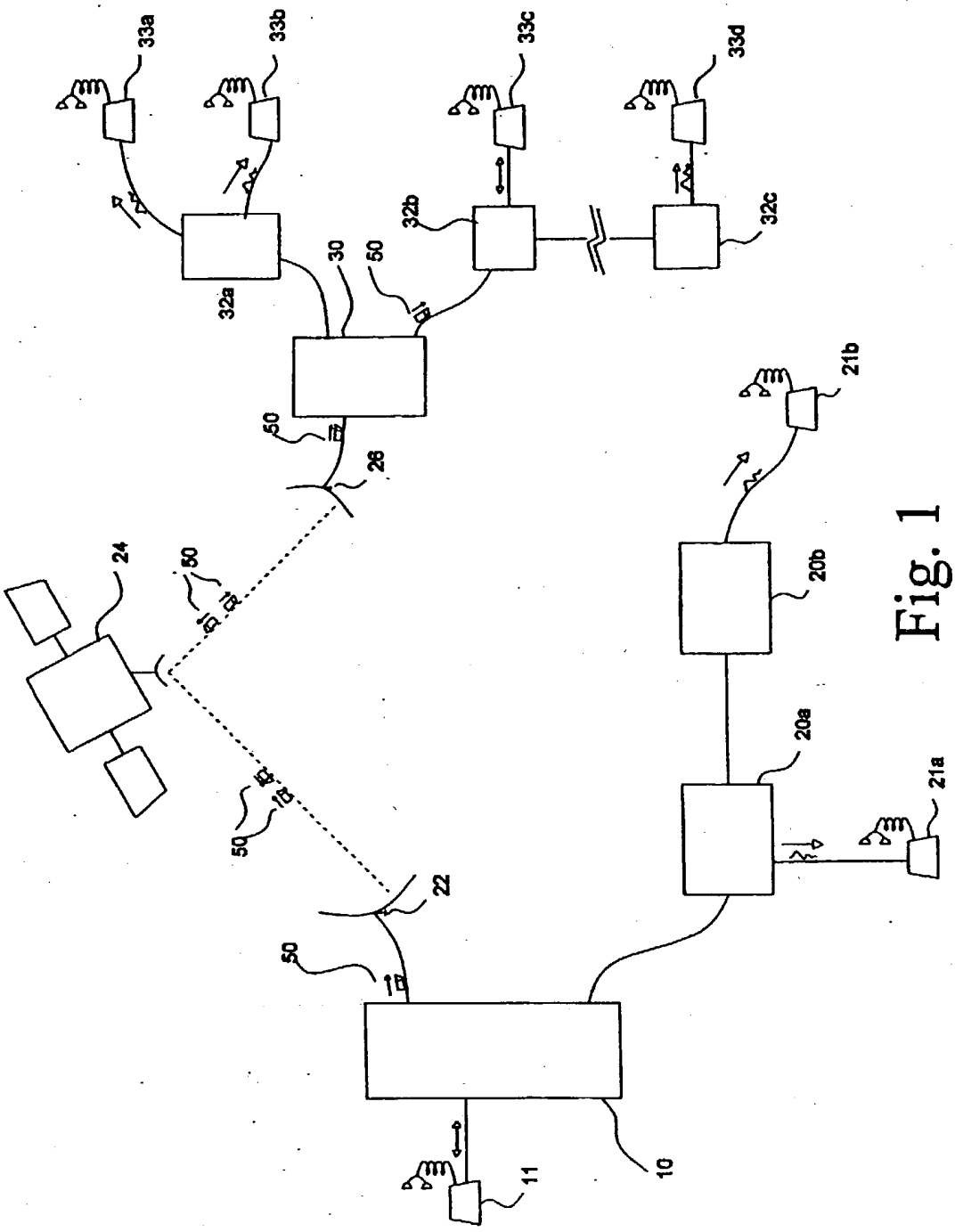

Fig. 1

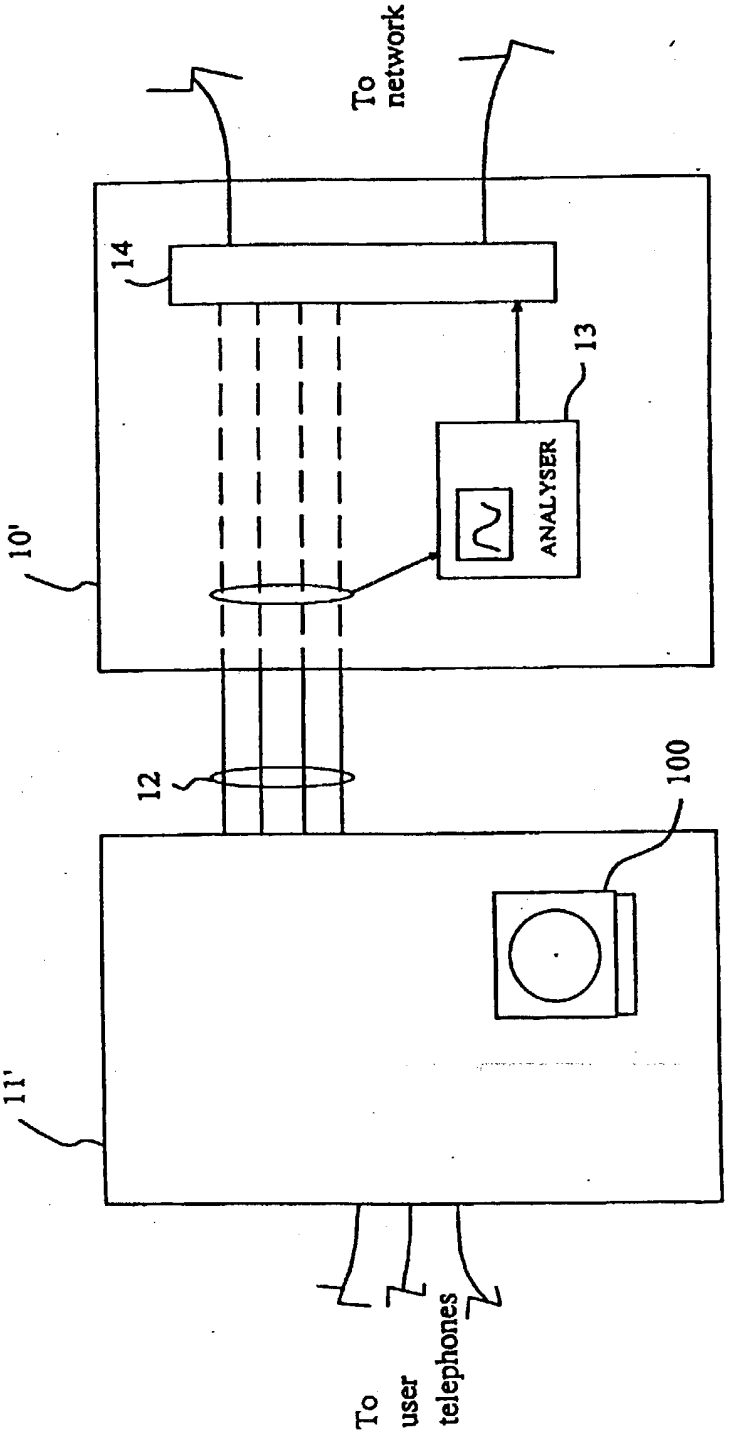

Fig. 2

Network Communication

The present invention relates to networks, particularly, but not exclusively, telecommunications networks, and is particularly applicable to networks such as the public telephone network. The invention is, however, applicable to other networks, including networks for transmitting video or other data, in which connections can be defined between distant points on the network.

In a telecommunications network, when a connection is defined between two points on the network, network resources are allocated to the connection. For example, in early analogue telephone systems, a physical wire connection was allocated. In current ATM-based networks, a virtual connection is allocated, defined by virtual path identifiers (VPIs) and virtual channel identifiers (VCIs).

The inventor has appreciated that in certain conditions, the useful information content of the information transmitted across the network is considerably less than the allocated network bandwidth. An example of such a situation in a telephone network is when a caller is in a queuing system or on hold and music is being played from the desired node to the user. In such a case an entire connection across the network, which may span many thousands of kilometres and involve relatively scarce or expensive network resources such as a satellite link is occupied, with little useful information being conveyed. The inventor has appreciated that this problem is particularly acute in the example mentioned above, since a modern ATM network employs statistical multiplexing to economise on bandwidth consumed. That is, in normal conversation, there are frequent pauses, so the flow of ATM cells carrying a conversation will not necessarily be continuous. If several conversations are carried along a single channel, the total bandwidth required will therefore be less than the sum of the peak bandwidths required by each conversation. Music on hold, however, is generally unceasing, so the full bandwidth is required to carry the music.

Also, music cannot be compressed as readily as voice, so greater bandwidth is in any event required to carry the data.

The present invention aims to provide more efficient use of network resources and to alleviate problems such as the above. Examples of other applications of the invention will be discussed below.

In a first aspect, the invention provides a method of operating a network comprising signalling that information to be transmitted from a source node to a destination node corresponds to information of a defined type; receiving said signalling and generating information corresponding to said information at a point in the network closer to the destination node than the source node.

In this way it is not necessary for the information to be transmitted across the entire network. By closer is meant topologically closer in terms of the route through the network; this may not always be physically closer. Signalling that the information is of a defined type is preferably achieved using significantly less network resources than the information itself and preferably comprises sending an identifier (or "description") of the information. The corresponding information is preferably generated for a period of time longer than the time required to transmit the identifier.

Preferably, the corresponding information is generated until a predetermined condition is met (for example a predetermined time has elapsed) or until the source node signals that information generation is to be stopped or different information is to be generated, or until the source node supplies "real" information to be transmitted to the destination. For example, in the case of music on hold, the source node may signal that music generation is to commence, and music may then be generated until one of the following:- (a) the destination (or source) node terminates the connection; (b) a predetermined time has elapsed and the network terminates the connection;

(c) the source node signals that it is unable to answer the call or (d) the source node answers the call and communication is established.

Signalling preferably originates from the source node, but may originate elsewhere, for example downstream of the source node.

It is to be noted that the invention is not limited to end-to-end communication across a network; the "source node" need not be the original provider of the information and the "destination node" need not be the ultimate destination of the information, but both may comprise intermediate network points. For example, information may be transmitted from a telephone via a local exchange across the network to a bridge to an independently managed network. In such a case, the local exchange may function as the source node as defined above and the bridge the destination node.

Where the information is generated at a point intermediate the source and destination node, the method includes transmitting the generated information to the destination node.

It is preferable for the information to be generated closer to the destination node than to the source node. Preferably, the network includes an access node, such as a local exchange to which the destination node is connected and the information is generated at said access node. The closer to the destination node that the information is generated, the greater are the network resources that can be freed by employing the invention. The information may even be generated at the destination node (in which case transmitting the information to the destination node is trivial), for example at a user's PABX or even in a user's telephone apparatus. The latter is particularly preferred in the case of a mobile telecommunications network, since the user's apparatus already includes significant processing power and there is no dedicated connection between the user's telephone and the base

station.

The invention may be employed in a call-queuing system in which messages or music indicating that the call is in a queue are generated at a node between a node which a user is trying to access and a user node (preferably at the user's local exchange), thereby enabling large numbers of users to be held in a queue without consuming significant network resources. This has the double advantage for a telecommunications network provider that a large number of users may be queued and that less network resources are consumed.

Another advantage is that the information generated may be customised for each user or group of users.

For example, a user may be able to select a choice of music or message to be played whenever that user is holding and the selected music or message may be generated by a local exchange, or even a device on the user's premises, such as a telephone, in response to receipt of a signal from a distant node.

Another advantage is that a message or music to be played can be selected according to the region in which the destination user is located. For example, in the case of an international call, a signal may be sent indicating that the caller is in a queue, or on hold, or that the line is engaged or ringing, or that the number is incorrect or unavailable, and an appropriate message in a local language, or a language selected by the user may be played.

Preferably, in the cases mentioned above, signalling that the information is of a defined type, together with a type identifier, is effected by the source node. For example, in the case of a telecommunications network based on ATM cells, a cell may be returned from the source node containing data indicating that it contains an identifier of information to be generated at a

remote network node rather than, for example, compressed voice data to be transmitted across the network.

Alternatively, the method may include sampling the information output from the source and determining whether the information corresponds to information of a defined type.

Where the information output from the source is sampled, the method may be applied to reduce network bandwidth required for a variety of different types of communication.

In one application, the method comprises interpreting speech input at the source node, transmitting information in coded form representing said interpreted speech across the network and, at or nearer to the destination node than the source node, generating an output corresponding to the interpreted speech. By interpreted speech is meant speech which has been at least partially analysed into components, for example syllables. This may result in a large saving in bandwidth. Moreover, the output need not necessarily be synthesised speech, but may be textural. Thus, with this application of the invention, a user may dictate a facsimile, electronic mail, telegram, pager or other message. Alternatively, synthesised voicemail messages may be stored. Another advantage is that the output may be in a different language from the input, if translation is provided in between the input and output.

Conventional voice-recognition systems exist, and these may be employed at the input end. Where a textural output is required, such systems may be sufficient. However, where a synthesised speech output is required, it is preferable if the recognition system also encodes at least some characteristics of the voice, for example whether the voice is male or female and preferably selects one of a plurality of voice types most closely resembling the speaker's voice. As an alternative to selecting from one of

a plurality of predefined voice types, the encoding may encode characteristics of the speaker's voice, or parameters enabling the speaker's vocal tract to be modelled. Preferably, if the encoding means is not able to interpret the speech, the system is arranged to transmit an uninterpreted, for example, PCM coded signal corresponding to the input voice.

Another preferred application is in the provision of recorded or computerised information services. In such a case, the source may be arranged to transmit text or other coded information across the network, using significantly less bandwidth than would be required to transmit recorded or synthesised speech, and speech may be synthesised at the destination.

Still another application of the invention is in the provision of video-on-demand services, where video is transmitted from a central server in response to a request from a subscriber. Video requires a comparatively high bandwidth to transmit, even in compressed form, for example compressed according to the MPEG-2 standard. Instead of transmitting all video requests from a central server, preferably at least one, and preferably several, preferably the most popular, video programme or programme segment is stored on an intermediate node, closer to a destination node than the server. Then, in response to a request for the stored programme, the server need only send an instruction to the intermediate node to play the programme, thereby freeing network resources in between the server and the intermediate node. The intermediate node may be updated by the server at times when there is available network bandwidth between the intermediate node and the server, rather than requiring a real-time connection. This aspect may be provided independently.

Other aspects and preferred features are set out in the claims.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a schematic overview of a telecommunications network according to a first embodiment;

Fig. 2 is a schematic diagram of a modified user switchboard and exchange for inclusion in a telecommunications network according to a second embodiment.

Referring to Fig. 1, in a network according to a first embodiment, an exchange 10 is connected to a telephone apparatus 11 which is provided with a call-queuing system according to the invention. The exchange 10 is coupled to an exchange 20a which is connected to a user apparatus 21a and a further exchange 20b which services a further user telephone apparatus 21b. The exchange 10 is also connected via a satellite link 22,24,26 to a remote exchange 30 to which are connected respective local exchanges 32a, 32b, the exchange 32a having two active user telephone apparati 33a, 33b connected. A further active user telephone apparatus 33c is connected to exchange 32b, and a yet further active user telephone apparatus 33d is connected to the exchange 32b by means of a further exchange 32c and intermediate network nodes, not shown. Of course, there are many other nodes and connected telephone apparatus in the network, each exchange typically servicing many hundreds or thousands of individual user connections and being interconnected to a large number of other exchanges; for simplicity other connections have not been indicated.

In the example depicted, six active users are attempting to contact a single user connected to telephone apparatus 11; such a situation may occur in a typical network where user 11 is offering over-subscribed tickets to a popular event, or following a broadcast advertisement, or in the case of a company's customer care service, where the provision of call-queuing enables the number of staff required to deal with customer concerns to be significantly less than the number of customers who may call at any particular time.

In the example shown, the user of telephone apparatus 33c is in active communication with the user of telephone apparatus 11, as represented schematically by the data packets (for example ATM cells) 50 flowing between the exchange 10 and the exchange 32b, via the satellite link and the intervening exchange 30. Communication between each telephone apparatus and the respective exchange is, in this example, analogue but this could be digital. In particular, the telephone apparatus 11 may be one of many similar apparati connected to a PABX which is connected by a digital link to the exchange 10.

As represented schematically by the arrows, analogue music signals are sent from each exchange to the connected telephone apparatus. Thus, while communication between user of apparatus 11 and user of apparatus of 33c is continuing in a conventional manner, five additional users are holding without consuming excessive additional network resources. In the example described above, no network resource are consumed beyond each user's local exchange. In practice, in order to make the system more abust, rather than simply sending a single data packet to initiate call holding, the network may be arranged so that packets are sent at regular intervals to maintain the call in the hold state, but this will still require significantly less resources than transmitting music across the network.

In the example described above, the exchange 10 may be arranged to detect that apparatus 11 is busy and to signal to exchanges requesting subsequent calls that music on hold is to be generated. Alternatively, the exchange 10 may send a request signal to the apparatus 11 when a new call request is received and either the telephone apparatus 11 or the exchange 10 may be arranged to generate a signal if the user of apparatus 11 does not accept the call. In both the above cases, the telephone apparatus 11 does not require the capability to play music on hold to multiple calls, which has the advantage that a simple apparatus can be employed.

In the case of existing conventional call queuing systems in which multiple calls are queued at a user's switchboard, a slightly different arrangement is employed.

Referring to Fig. 2, the arrangement of a user switchboard 11' and a modified exchange 10' according to a second embodiment will now be explained. The user switchboard 11' is connected by multiple connections 12 to the exchange 10'. These connections 12 may be physically distinct or may be carried in a single connection, for example a digital connection; the details are not critical. The switchboard 11' includes a music generation system 100 for generating music to be played when a call is on hold, for example a compact disc player. All features of the switchboard may be entirely conventional; this is an advantage of this arrangement as no modification is required at the user premises.

The exchange 10' includes a music detector 13 which is arranged to sample the communication on each of the connections 12 from the switchboard 11'. When music on hold is detected (which can be achieved by means of conventional sound analysis and recognition apparatus and software), the detector 13 signals to the network interface 14 that music on hold is being played. The network interface then, in place of transmitting the music across a network, transmits a special information carrying cell signalling that music on hold is to be generated elsewhere in the network. Thus, in this embodiment, modification is only required in the exchange, and can yield a saving in network bandwidth for the telecommunications supplier without causing any inconvenience for the customer.

To facilitate identification of the music on hold, the music played can be selected deliberately to facilitate detection. In particular, if the detector 13 is provided with information concerning the music that will be played, detection may be made easier or more reliable. If the "music" is replaced by a simplified signal such as pink noise (for example a continuous tone or

collection of tones), the detector 13 can also be simplified. This can be achieved relatively easily simply by providing the user with, for example, a compact disc containing pre-recorded tones.

The examples described above are concerned with reducing network bandwidth required when music on hold is to be played. In a modification of the embodiment of Fig. 2, a more complicated analyser may be provided in place of detector 13 to analyse and interpret speech. This interpreted speech may then be transmitted in coded form for later synthesis, translation, or conversion to a different data type (for example facsimile or email).

The invention has been described above in the context of a fixed network but is equally applicable to fixed and mobile networks. In the case of mobile networks in particular, it is desirable if the information to be generated is generated, at least partially, in the mobile handset. This may make bandwidth available so that more mobile devices may share the same frequency band or physical region. In the case of a mobile network, referring back to the embodiment of Fig. 1, the local exchanges 32a...32c would correspond to base stations in cells and the handsets 33a...33d would be mobile devices, linked to the base stations by radio communication channels.

While the invention may offer considerable savings when employed in a telecommunications network, it is also applicable to smaller, local, networks; whatever the size of network, a saving in network bandwidth may be advantageous.

Numerous other applications of the invention will be apparent. For example, frequently occuring lengthy data portions of IP packets may be recognised and a signal sent enabling the data portion of the packet to be reconstructed

downstream in the network, provided it can be assured that the packet will pass through a device which is arranged to reconstruct the packet. The signalling information may be transmitted with a portion (for example the header) of the original packet.

Each feature disclosed herein may be independently provided unless otherwise stated.

Claims

1. A method of operating a network comprising signalling that information to be transmitted from the source node to a destination node corresponds to information of a defined type; receiving said signalling and generating information corresponding to said information at a point in the network closer to the destination node than the source node.

2. A method according to Claim 1, wherein signalling comprises sending an identifier of the information.

3. A method according to Claim 1 or 2, wherein the corresponding information is generated for a period of time substantially longer than the signalling time.

4. A method according to any preceding claim wherein the corresponding information is generated until a predetermined condition is met.

5. A method according to any preceding claim wherein the corresponding information is generated at a point intermediate the source and destination node, including transmitting the generated information to the destination node.

6. A method according to any preceding claim wherein the corresponding information is generated closer to the destination node than to the source node.

7. A method according to any preceding claim, wherein the network includes an access node to which the destination node is connected and the corresponding information is generated at said access node.

8. A method according to any of Claims 1 to 6, wherein the

corresponding information is generated at the destination node.

9. A method according to any preceding claim, wherein the destination node comprises a telephone.

10. A method according to any preceding claim for queuing calls, wherein said information comprises messages or music indicating that the call is in a queue.

11. A method according to any preceding claim, wherein the information generated is selectable independently of the signalling.

12. A method according to any preceding claim, wherein signalling that the information is of a defined type, together with a type identifier, is effected by the source node.

13. A method according to any of Claims 1 to 11 including sampling the information output from the source and determining whether the information corresponds to information of a defined type.

14. A method according to any preceding claim wherein the information to be transmitted comprises speech, the method comprising interpreting and coding the speech and transmitting the coded interpreted speech as said signalling.

15. A method according to Claim 14, wherein generating corresponding information comprises synthesising speech.

16. A method according to Claim 14, wherein generating corresponding information comprises providing a legible output.

17. A method of transmitting speech across a telecommunications

network comprising interpreting and coding the speech, transmitting the interpreted coded speech across the network from a source to a destination and synthesising speech or legible output at the destination based on the interpreted coded speech.

18. A method according to any of Claims 14 to 17 including translating the speech.

19. A method according to any of Claims 1 to 13, wherein the information to be transmitted comprises video, the method comprising transmitting an identifier of the video to a video store at an intermediate point in the network and outputting the video from the store to generate said corresponding information.

20. A network including:

a source node;

a destination node;

means for signalling that information to be transmitted from the source node to a destination node corresponds to information of a defined type;

means for receiving said signalling and generating information corresponding to said information at a point in the network closer to the destination node than the source node.

21. A device for use in a network according to Claim 20, the device comprising:

means for transmitting information of a first type;

means for signalling that information of a second type is to be generated downstream in the network.

22. A device according to Claim 21, including means for analysing information received to determine whether it is of said first or second type.

23. A device according to Claim 21 or 22, wherein said first type is speech and said second type is music, silence, or signalling tones.

24. A device for use in a network according to Claim 20, the device comprising:

means for receiving information for output;

means for receiving signalling information;

means for generating information for output based on the signalling information;

means for outputting received information and generated information via a common output channel.

25. A distributed call queuing system comprising:

means for signalling at a source node that an incoming call is to be queued;

means at a remote node, closer to the originator of the incoming call, for generating a hold message or music in response to said signalling.

26. A method of operating a network substantially as any one herein described.

27. A device for use in a network or a network substantially as any one herein described or as illustrated in any figure.

The Patent Office

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Application No: GB 9821861.3 **Examiner:** Mark Bell
Claims searched: 1 to 16, 19 to 27 **Date of search:** 14 February 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H4K (KTA)

Int Cl (Ed.7): H04Q 3/00, H04M 3/00

Other: ONLINE: WPI, PAJ, EPODOC.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 98/06209	HAZENFIELD (see page 3 lines 24 to 27)	1 to 12, 20, 24, 25
X	US 5664948	DIMITRIADIS et al. (See abstract)	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.